

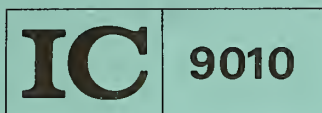
TN 295

.U4

No. 9010







Bureau of Mines Information Circular/1985

Mining Health and Safety In-House and Contract Research in Fiscal Year 1985

By Staff, Bureau of Mines



UNITED STATES DEPARTMENT OF THE INTERIOR



(United States Bureau of Mines)

Information Circular 9010

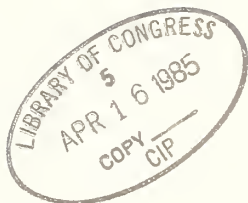
Mining Health and Safety In-House and Contract Research in Fiscal Year 1985

By Staff, Bureau of Mines



UNITED STATES DEPARTMENT OF THE INTERIOR
Donald Paul Hodel, Secretary

BUREAU OF MINES
Robert C. Horton, Director



TN295
.U4
no. 9010

Library of Congress Cataloging in Publication Data:

United States. Bureau of Mines.

Mining health and safety in-house and contract research in fiscal year 1985.

(Information circular ; 9010)

Supt. of Docs. no.: I 28,27:9010.

1. Mine safety--Research--United States. 2. Miners--Diseases and hygiene--Research--United States. I. Title. II. Series: Information circular (United States. Bureau of Mines) ; 9010.

TN295.U4 622s [622'.8'072073] 84-600391

CONTENTS

Page

Abstract.....	1
Introduction.....	1
Program outline.....	2
Part 1.--In-house research.....	2
Health.....	2
Respirable dust.....	2
Control of dust formation.....	2
Control of generated dust.....	3
Dust instrumentation and measurement.....	4
Radiation hazards.....	4
Control of radiation hazards.....	4
Radiation instrumentation and measurement.....	4
Noise control.....	4
Industrial hygiene (toxic substances).....	5
Toxic gases and materials.....	5
Diesel engine and alternative power sources.....	5
Ventilation.....	6
Safety.....	6
Fire and explosion prevention.....	6
Prevention and detection.....	6
Ignition control and suppression technology.....	6
Propagation and extinguishment.....	7
Methane control.....	7
Fundamental factors.....	8
Control during mining.....	8
Ground control.....	8
Mine design and development.....	8
Hazard detection and monitoring systems.....	10
Roof support systems.....	10
Safe support installation.....	12
Waste stability.....	12
Industrial-type hazards.....	13
Electrical.....	13
Illumination.....	13
Mine communications and monitoring.....	14
Human factors.....	14
Mine equipment safety.....	15
Haulage and materials handling.....	15
Postdisaster.....	16
Survival.....	16
Communications.....	16
Rescue and mine recovery.....	16
Explosives.....	16
Systems engineering.....	17
Systems analysis.....	17
Test facilities.....	17
Assistance with program management.....	18

CIP bc 99 12-6-84

bc 15 4-30-85

CONTENTS--Continued

	<u>Page</u>
Part 2.--Contract research.....	18
Health.....	18
Respirable dust.....	18
Noise control.....	18
Industrial hygiene (toxic substances).....	19
Ventilation.....	19
Safety.....	19
Ground Control.....	19
Mine design and development.....	19
Hazard detection and monitoring systems.....	19
Waste stability.....	19

UNIT OF MEASURE ABBREVIATIONS USED IN THIS REPORT

m meter

pct percent

MINING HEALTH AND SAFETY IN-HOUSE AND CONTRACT RESEARCH IN FISCAL YEAR 1985

By Staff, Bureau of Mines

ABSTRACT

This publication summarizes the research (in-house and contract projects) programmed by the Bureau of Mines for fiscal year 1985 (October 1, 1984-September 30, 1985) under its Health and Safety Technology Program. The objective of these projects is to provide an ordered and sequenced advance toward the Bureau's overall goal of providing the systems technology required to create a more healthful and safer working environment for the Nation's mining and minerals processing workers.

INTRODUCTION

The Bureau of Mines conducts a balanced, continuing in-house research and development program to accelerate systematic improvements in health and safety conditions in U.S. mines. Part 1 of this report outlines the Bureau's present in-house effort to all interested parties; in particular, potential contractors can refer to it when submitting USP's (unsolicited proposals), thus avoiding proposing research that duplicates work being performed by the Bureau. Part 2 outlines the Bureau's current projected contract research needs.

Contracts for the Health and Safety Technology Program will be awarded in strict accordance with Federal Procurement Regulations. Availability of requests for proposals (RFP's) will be formally advertised in the Commerce Business Daily. No additional information will be supplied on these projects until after the RFP's are made available and then only in strict accordance with prescribed procedures. This document is not intended to solicit proposals from the contracting community. All USP's whose content reflects the objective(s) of the proposed projects listed herein will be returned without formal review.

PROGRAM OUTLINE

The objective of the Health and Safety Technology Program is to protect the health and safety of mining and minerals processing workers while ensuring that newly developed technology incorporates health and safety criteria. In achieving this objective, four fundamental and complementary requirements must be considered by the research program:

1. Contributing to the viability of a basic industry.
2. Sustaining productivity.
3. Allowing for a return on capital investment.
4. Providing material and energy to the public.

Since mining and minerals processing involve a highly integrated and inter-related set of functions, the program has been divided into a set of interrelated subprograms, each with goals that will provide systems technology solutions to the problems within the framework of these fundamental requirements.

The Health and Safety Technology Program is divided into 12 subprogram areas as shown:

Health

Respirable Dust
Radiation Hazards
Noise Control
Industrial Hygiene
Ventilation

Safety

Fire and Explosion Prevention
Methane Control
Ground Control
Industrial-Type Hazards
Postdisaster
Explosives
Systems Engineering

The objectives of these subprograms are described in the following pages, followed by the planned projects and their corresponding descriptions. The aggregate value of the planned in-house projects is approximately \$25.5 million, and that of the anticipated contracts is \$1.8 million.

PART 1.--IN-HOUSE RESEARCH

HEALTH

Respirable Dust

Program Objectives: To investigate basic dust control technologies and concepts aimed at both preventing the formation of respirable dust and controlling the airborne dust generated during the mining cycle. To provide new and improved technology for measuring and controlling airborne respirable dust at levels that meet or are below standards set by the Federal law for all mining and mineral processing operations.

Control of Dust Formation

1. Define the Empirical Relationship Between Cutting Parameters, Dust Generation, and Cutting Forces for Coal and Rock

Objective: To conduct basic studies to determine the relationships between forces, energy, primary dust generation, and cutting parameters for coal type, bit geometry, and bit usage, and establish a generic mathematical model to optimize cutting systems for minimum dust generation. To install a prototype

continuous miner cutting drum in a test facility to evaluate a linear depth of cut design. This is a continuation of an ongoing project.

2. Fundamentals of Dust Formation and Entrainment

Objective: To initiate laboratory studies to define the basic parameters of coal and quartz during breakage and how the parameters affect the formation and entrainment of airborne respirable dust. This is a continuation of an ongoing project.

3. Study of Coal Dust Wettability

Objective: To determine the critical performance parameters of surfactants for coal wetting and define the characteristics of a universal surfactant. To investigate the effects of coal surface chemistry on wettability. This is a continuation of an ongoing project.

4. Mine Inspection Data Analysis System

Objective: To conduct a statistical analysis of available dust exposure data and complete the development of the exposure index that will aid the Mine Safety and Health Administration (MSHA) in determining its future inspection and sampling strategy. To expand this analysis to involve other airborne contaminants. This is a continuation of an ongoing project.

Control of Generated Dust

5. Determination of the Extrinsic Parameters Governing the Quartz Exposure of Coal Mine Workers

Objective: To identify the specific dust sources in both underground and surface operations to direct control technology concepts. Emphasis is on sources that generate more than 5 pct quartz in the mine atmosphere. To determine if operations are expected to operate under more stringent standards due to silica dust for the life of the operation or whether this condition will vary. This is a continuation of an ongoing project.

6. Behavior and Transport of Silica Dust in Room and Pillar Mining Operations

Objective: To study the ventilation patterns and airflow characteristics at room and pillar operations and determine their effect on the behavior and transport of silica dust. To identify specific areas where silica dust behaves differently from coal dust and determine how dust control practices need to be modified to compensate for these differences. This is a continuation of an ongoing project.

7. Investigation of Quartz Dust Generation During the Removal of Overburden Material at Surface Coal Mines

Objective: To identify and quantify silica dust sources at surface coal operations with special emphasis on sources governing the dust exposure of highwall drill operations. This is a continuation of an ongoing project.

8. Identification and Study of the Elemental Sources and Behavior of Respirable Dust as It Relates to Longwall Dust Control

Objective: To identify and characterize the sources and behavior of respirable dust in longwall mining operations and to evaluate dust control concepts. Quantify the effectiveness of longwall dust control measures including dust suppression techniques, as well as administrative procedures as they affect the dust exposure of the face workers. This is a continuation of an ongoing project.

9. Define and Characterize Sources of Mill Dust and Its Control

Objective: To conduct studies to identify and control dust sources and generation in mineral processing plants and mills. Complete the evaluation of the new concept vacuum nozzle fill method for packaging mineral ores with high silica content. This is a continuation of an ongoing project.

Dust Instrumentation and Measurement

10. Study of Respirable Dust Monitoring Strategies and Evaluation of Dust Measurement Concepts

Objective: To evaluate the performance of real-time, continuous reading dust monitors for research and for enforcement use. Instruments include the Tapered Element Oscillating Microbalance and light-scattering optical instruments. Continue development of a monitoring strategy for controlling respirable coal mine dust that uses real-time monitoring instruments. This is a continuation of an ongoing project.

11. Determination of Silica Particle Size Distribution in Respirable Mine Dust Samples

Objective: To determine the size distribution of mineral particulates collected from underground coal mines by scanning electron microscope (SEM) image analysis with special emphasis on size of silica particulates as related to the various coal seams. To initiate similar analysis of hardrock mining operations. This is a continuation of an ongoing project.

Radiation Hazards

Program Objective: To advance the state of measurement and control technology for protection of miners from exposure to radon and radon daughters and other nuclear radiation hazards in uranium and other mines.

Control of Radiation Hazards

1. Radon Control Technology

Objective: To define and investigate the parameters that influence the release of radon from radium-bearing ores, and develop a computer model of the release of radon into the mine atmosphere considering ventilation pressures, mining activities, and inactive mines. This is a continuation of an ongoing project.

Radiation Instrumentation and Measurement

2. Personal Exposure Measurement Technology

Objective: To complete the use of passive alpha detectors for radon measurements and study methods for measuring long-lived alpha emitters. To determine physical characteristics of radon daughters in mine atmospheres. To continue to evaluate the accuracy and reliability of emerging radiation measurement technology. This is a continuation of an ongoing project.

Noise Control

Program Objectives: To reduce mine worker overexposure to noise by conducting research in noise source identification, noise control technology, and hearing protector research.

1. Hearing Protector Research

Objective: To determine the actual protection provided by hearing protectors under working conditions in the mining environment. To complete the development of a two-microphone attenuation measurement method that can be used in underground mines. This is a continuation of an ongoing project.

2. Noise Control of LHD Vehicles

Objective: To devise and evaluate cost-effective retrofit and factory-integrated noise controls for underground diesel-powered load-haul-dump (LHD) vehicles. This is a continuation of an ongoing project.

3. Chain Conveyor and Gear Research

Objective: To conduct basic studies into noise generating mechanisms of chain conveyors and mining equipment gear trains which have been identified as significant noise sources. This is a continuation of an ongoing project.

4. Investigations of Percussive Drill Noise Control

Objectives: To conduct studies into the noise generation mechanisms of drill steel and study new engineering design concepts to reduce the noise of percussive drills. This is a continuation of an ongoing project.

5. Noise Abatement Profile

Objectives: To establish a computer data noise abatement profile that will assess worker overexposure to noise and evaluate cost benefit studies. This is a continuation of an ongoing project.

Industrial Hygiene (Toxic Substances)

Program Objectives: To identify and control health hazards in surface and underground mines and mineral processing plants caused by toxic gases and fumes, and certain particulates produced by explosives, combustible materials, and diesel engines. To develop and evaluate new instrumentation for monitoring these substances. To develop and/or refine analytical techniques for measuring and characterizing toxic substances, and investigate methods for controlling the formation and accumulation of toxic products. To analyze alternative power sources that may have health advantages over existing mine diesels.

Toxic Gases and Materials

1. Toxic Fumes From Explosives and Other Materials Used in Mining

Objective: To determine the identity and quantity of fixed gases, chemical vapors, and residues produced by the detonation of explosives and by the thermal oxidative degradation and combustion of materials used in underground mining operations. To determine the effect of low-order reaction due to marginal primary, deteriorated explosives, or to improper delay intervals in the production of toxic fumes during blasting. This is a continuation of an ongoing project.

2. Monitoring and Measurement of Contaminant Gases

Objective: To devise and evaluate methods and devices that can be used effectively and efficiently by the mining industry to evaluate, maintain, and improve the working environment in underground mines. This is a continuation of an ongoing project.

3. Cyanide Hazard in the Mining Industry

Objective: To identify cyanide hazards associated with the use of cyanide solutions in leaching gold and silver ores and as a depressant in the beneficiation of sulfide ores. Determine chemical or physical means of reducing the identified hazards. This is a new project.

4. Measurement and Control of Welding Fumes

Objective: To assess related industry practices pertaining to measurement and control of welding and cutting fumes, dust, and radiation, and adapt this technology to confined work areas found in the mining environment. To determine the quantity and character of welding pollutants and personnel exposure levels. This is a continuation of an ongoing project.

Diesel Engine and Alternative Power Sources

5. Research To Control Diesel Engine Exhaust Emissions

Objective: To complete instrumentation of the diesel test cell to perform state-of-the-art research on measurement and control of gaseous and particulate emissions from diesel engines. To determine the efficiency of ceramic, wall-flow particulate filters and assess products of combustion of commonly used fuel additives used by the industry. This is a continuation of an ongoing project.

Ventilation

Program Objectives: To design ventilation systems required to maintain a safe and healthful atmosphere conducive to efficient work output in noncoal mines.

1. Improving Ventilation in Noncoal Mines and Mills

Objectives: To investigate the aerodynamics of face ventilation systems in large opening mines, to document a thermal energy recovery system for reducing mine refrigeration and energy needs of hot mines, and to investigate improved mine stopping construction techniques, especially in large-opening mines. This is a continuation of an ongoing project.

SAFETY

Fire and Explosion Prevention

Program Objectives: To reduce the potential for a fire or explosion in mineral extraction and processing operations, to minimize the danger to people on account of fires or explosions that do occur, and to diminish the vulnerability to such attendant hazards as high temperature, asphyxiating and toxic fumes, and explosive gas mixtures.

Prevention and Detection

1. Investigation of Fundamental Approaches to Fire Warning in Underground Mines Including Stench Gas, CO Indicators, and Human Response

Objective: To reduce fire warning time for deep underground metal mines and ensure appropriate response by miners to warning signals. This is a continuation of an ongoing project.

2. Hazard Detection and Instrumentation

Objective: To identify, evaluate, and improve upon promising fire sensors and fire-sensing systems for use in underground mines. To develop prototype

systems capable of (1) remote measurement of methane and other flammable gases and (2) low-level smoke sensing. This is a continuation of an ongoing project.

3. Implementation of Coal Dust-Rock Dust Regulations

Objective: To provide improved instrumentation to enable MSHA to more readily determine compliance with current rock dust regulations. To field test the Bureau prototype reflective rock dust meter in several operating coal mines. To maintain awareness of non-rock-dust alternatives for explosion prevention. This is a continuation of an ongoing project.

4. Fires in Mine Passageways

Objective: To provide data on mine fire parameters, such as fire growth rate, ignition source intensity, fire size, and yields of toxic combustion products that can lead to improved and realistic fire detection and a more realistic planning of fire emergency procedures. This is a continuation of an ongoing project.

5. Characterizing the Effect of the Mining Environment on Underground Metal Mine Fire Detection

Objective: To perform highly complex analyses of fire growth and containment spread using real-time inputs from in-mine detection instruments. This is a continuation of an ongoing project.

Ignition Control and Suppression Technology

6. Feasibility and Ignitability Testing of Mineral Dusts, Gases, and Vapors

Objective: To develop and promulgate new and more reliable explosivity and ignitability indices for use in classifying dusts according to their hazard potential. Continue thermal and spark-ignitability studies in a new and larger furnace to permit more accurate control over the environments simulated as a

representation of those encountered in mine. To delineate the domain of flammability for mixtures of coal dust-rock dust-methane in air. To find new, cost-effective supplements or substitutes for rock dust. This is a continuation of an ongoing project.

7. Fire Hazards of Mine Combustibles

Objectives: To evaluate flame spread rates of mine materials under sloping conditions. This is a continuation of an ongoing project.

8. Pacification of Sulfide Oxidation

Objective: To determine the kinetics and mechanisms of low-temperature oxidation of sulfides, particularly pyrrhotite and zinc, so as to identify the rate-controlling step(s). To apply the result of this study to identify chemical and physical inhibitors and validate, first in large-scale laboratory tests and ultimately in mines, the ability of these inhibitors to prevent or retard sulfide oxidation and thereby reduce the probability of mine fires and resultant loss of property and life. This is a continuation of an ongoing effort.

9. Spontaneous Combustion Research

Objective: To study the self-heating of materials under realistic conditions in order to provide criteria for prediction and prevention of spontaneous combustion occurrences. This is a continuation of an ongoing project.

10. Microscopic Structure and Composition of Combustible Dusts and Residues

Objective: To conduct quantitative microscopic structure studies, size distributions, and composition analyses of various dusts after laser pyrolysis exposure with the scanning electron microscope or electron microscope, and to apply the data obtained to combustion research and the forensic science of postdisaster investigation. This is a continuation of an ongoing project.

Propagation and Extinguishment

11. Fire and Explosion Hazards of Oil Shale Mining and Oil Mining

Objective: To provide guidelines for fire and explosion prevention during all phases of oil shale mining and processing. This is a continuation of an ongoing project.

12. Full-Scale Mine Explosion Research

Objective: To study the ignition, propagation and suppression of full-scale explosions of coal dust, oil shale dust, and gas in the Bruceton and Lake Lynn Experimental Mines; and to improve and maintain the instrumentation in both facilities. This is a continuation of an ongoing project.

13. Prevention and Suppression of Ignitions and Explosions

Objective: To develop, test, and conduct field trials of (1) new tool bit geometries for the prevention of face ignitions, (2) barriers for the suppression of gas and coal dust explosions, and (3) two prototype wet head continuous miners. This is a continuation of an ongoing project.

14. Mine Fire Diagnostics

Objective: To develop needed guidelines for safe reopening of a mine following sealing of a coal mine fire, to evaluate mine fire detection and suppression systems, and to evaluate full-scale fires involving other mine combustibles such as mine dusts, brattice curtains, and conveyor belts. This is a continuation of an ongoing project.

Methane Control

Program Objective: To develop the technology that will enhance the ability of the mining industry to more effectively control methane in underground coal mines. The technology involved ranges from determining the fundamental factors influencing the occurrence of methane

to the development of techniques to control methane in advance of and during mining.

Fundamental Factors

1. Fundamental Factors Affecting Methane in Coal and Associated Strata

Objective: To determine the influences of geology on the occurrence and emission of methane. This is a continuation of an ongoing project.

2. Understanding the Mechanisms of Gas Outbursts in Coal

Objective: To assess the potential for and the minimizing of gas outburst hazards in coal mines. This is a continuation of an ongoing effort.

3. The Geology of Methane in Metal and Nonmetal Mines

Objective: To determine the influence of geology on the occurrence and emission of methane in metal and nonmetal mines. This is a continuation of an ongoing project.

Control During Mining

4. Protection of Methane Drainage Systems

Objective: To investigate improved techniques for protecting methane drainage systems. This is a continuation of an ongoing project.

5. Methane Drainage for Low Permeability Coalbeds

Objective: To influence horizontal drilling and completion technology for use in low-permeability coalbeds. This is a continuation of an ongoing project.

6. Longwall Gob Gas Control Using Cross Measure Boreholes

Objective: To evaluate new techniques for gob degasification. This is a continuation of an ongoing project.

7. Development of Methane Control Strategies in Metal and Nonmetal Mines

Objective: To develop and evaluate specific methane control strategies for metal and nonmetal mines. This is a continuation of an ongoing project.

8. Ventilation for Methane Control

Objective: To conduct research on improved ventilation techniques for methane control in coal mines. This is a continuation of an ongoing project.

Ground Control

Program Objectives: To develop technology that can be applied by the mining industry to reduce accidents due to the failure of underground mine roof, face, and ribs, and the collapse of surface mine and waste embankment slopes.

Mine Design and Development

1. Engineering Data Base for Coal Mine Ground Control Planning

Objective: To develop and establish a centralized geological and engineering data base for coal mine ground control planning and design. This is a continuation of an ongoing project.

2. Structural Analysis and Design for Longwall Mining

Objective: To apply numerical modeling techniques to identify optimum entry configurations, pillar designs, and single-entry development for longwall mining of steep coal seams and multiple seams. This is a continuation of an ongoing project.

3. Field Investigation of Coal Mine Pillar Design

Objective: To identify major problems related to current designs of chain pillars and barrier pillars, and validate the design concepts using field

instrumentation data and regressive integrity factor analysis. This is a continuation of an ongoing project.

4. Geophysical Validation of Coal Mine Pillar Integrity

Objective: To complete evaluation of geophysical methods for determination of the extent of and characteristics of yielded zones in coal mine pillars. This is a continuation of an ongoing project.

5. Evaluate Borehole Instruments for Rock Mechanics Investigations

Objective: To complete field and laboratory evaluation of the borehole shear tester, the improved borehole pressure cell, the two-component physical property gage, and the soft borehole deformation gage. This is a continuation of an ongoing project.

6. Roof and Pillar Stability at Coal Mine Intersections

Objective: To analyze stresses and deformations in the roof and ribs at entry intersections of coal mines using numerical modeling techniques, and verify the results with field measurement of convergence and stresses. This is a continuation of an ongoing project.

7. Stress Technology for Improved Mine Design

Objective: To complete field evaluation of the effect of in situ stress fields on ground control problems and the potential of stress technology in improving mine structural design. This is a continuation of an ongoing project.

8. Application of Geodynamic Accumulated Strain Sensor to In Situ Rock Stresses Measurement

Objective: To develop acoustic transducers for in situ rock stress measurement based on pulsed-phase-locked-loop

technology and demonstrate their application. This is a continuation of an ongoing project.

9. Geologic Studies for Coal Mine Ground Control

Objective: To classify hazardous geologic features of coal mine roof and identify suitable roof support techniques. This is a continuation of an ongoing project.

10. Fundamental Studies of Mountain Bumps in Eastern Coalfields

Objective: To investigate geologic parameters and mining practices relative to mountain bump phenomena in eastern coalfields. This is a new project.

11. Model Studies and Field Verification of Roof Bolting Criteria

Objective: To develop design guidelines for mine roof reinforcement using various types of roof bolts by collating the results of full-scale model testing, finite-element computer analysis, and in-mine tests. This is a continuation of an ongoing project.

12. Ground Control Planning for Deep Vein Mines

Objective: To develop a stability forecasting method using advanced numerical modeling techniques for ground control planning in deep-vein mining. This is a new project.

13. Mechanics and Control of Time-Dependent Deformation Around Deep-Vein Mine Openings

Objective: To investigate the mechanics of time-dependent rock deformation in deep vein mines, complete field evaluation of the improved seismic rock burst monitoring system with fiber optic data transmission, and develop ground control design criteria to prevent catastrophic

rock failure. This is a continuation of an ongoing project.

14. Engineering Properties of Coal Measure Rocks

Objective: To complete documentation and publication of laboratory test results on engineering properties of coal measure rocks. This is a continuation of an ongoing project.

Hazard Detection and Monitoring Systems

15. Coal Mine Bounce and Outburst Studies

Objective: To assess the reliability of low-frequency and high-frequency microseismic monitoring techniques to delineate areas of eventual coal bounce and outburst failure. A capability for automatic, real-time microseismic monitoring in underground coal mines shall be achieved. This is a continuation of an ongoing project.

16. Three-Dimensional Remote-Sensing Data Analysis for Mine Hazard Prediction

Objective: To investigate a composite methodology to construct three-dimensional mine hazard maps by combining satellite imagery data, aerial photographs, geologic and geophysical information, and digital terrain mapping. This is a continuation of an ongoing project.

17. In-Seam Hazard Detection Using Geophysical Techniques

Objective: To evaluate the reliability and accuracy of high-resolution guided wave seismic and radar technologies and the ultrasonic face scanner in detecting and locating hazardous geologic features and mine voids within a coal seam. This is a continuation of an ongoing project.

18. Acoustic Cross-Borehole Hazard Detection Systems

Objective: To complete assembly of the low-frequency, acoustic cross-borehole hazard detection system, install the instrumentation in a field logging vehicle, and conduct performance tests. This is a continuation of an ongoing project.

19. Prediction and Control of Rock Bursts and Failures in Mines

Objective: To continue collection of microseismic and electromagnetic radiation data at the Galena Mine and establish the conceptual viability of using electromagnetic radiation measurement to improve failure prediction capability. This is a continuation of an ongoing project.

20. Critical Parameters Controlling Roof Stability

Objective: To investigate roof-to-floor closure rate criteria for roof fall prediction using potentiometric and ultrasonic closure rate devices. This is a continuation of an ongoing project.

Roof Support Systems

21. Arch Canopy Research

Objective: To determine the dynamic response of arch canopies, their structural components, and tunnel liner fill systems to impact loading. This is a continuation of an ongoing project.

22. Fundamental Drill and Bolt Parameters Affecting Roof Integrity

Objective: To determine if roof bolts can be installed with uniform tension in widely varying roof conditions and determine roof stability that results. This is a continuation of an ongoing project.

23. Ground Control System Safety Analysis

Objective: To examine ground control accident reports to determine trends and to suggest needed Bureau research. This is a continuation of an ongoing project.

24. Inorganic Cementing Materials

Objective: To complete the development of chemical binders and methods of application to mine roofs to increase the mine roof stability, with special attention to potential inorganic binders. This is a continuation of an ongoing project.

25. Investigation of Factors Associated With Cutter (Shear) Roof

Objective: To perform engineering and geologic studies to determine causes of cutter roof. This is a continuation of an ongoing project.

26. Support of Thick Coal Roofs in Western Mines

Objective: To determine optimum support devices for safe, effective support of underground mine roofs composed of thick top coal. This is a continuation of an ongoing project.

27. Support for Large Underground Openings

Objective: To formulate, develop, and test concepts for ground support systems to stabilize large underground openings in thick-seam coal. This is a continuation of an ongoing project.

28. Passive Roof Supports To Control Ground

Objective: To develop fundamental data on the function of passive, artificial yielding roof supports used during

mining. This is a continuation of an ongoing project.

29. Corrosion of Metallic Roof Support Elements

Objective: To develop guidelines to aid MSHA and mining personnel in predicting the life of roof support systems, determine detrimental effects of corrosive mine environments on metallic roof supports, and help identify potential control measures. This is a continuation of an ongoing project.

30. Nontensioned Rock Reinforcement

Objective: To develop nontensioned, full-column inorganic grouted rock bolts for use in metal and nonmetal mines; complete testing of a scaler for use in metal and nonmetal mines. This is a continuation of an ongoing project.

31. Minimum Column Lengths for Resin-Grouted Bolts in Evaporites

Objective: To complete the determination of the minimum column lengths required to ensure safe working conditions when rock conditions are such that some grout is forced out into the rock mass. This is a continuation of an ongoing project.

32. Flexible Distributed-Load Support System

Objective: To define the interactive mechanics of flexible distributed-load supports; to determine the critical parameters that control the selection of backpacking materials; and to establish and verify a theory for flexible distributed-load support that will lead to effective design and implementation of the systems. This is a continuation of an ongoing project.

33. Roof Bolt Effectiveness Monitoring Using High-Frequency Microseismic System

Objective: To evaluate data analysis techniques of self-generated rock noise (ultrasonic frequency range) as related to dynamic structural response in underground mines. This is a continuation of an ongoing project.

Safe Support Installation

34. Support-Rock Interaction Mechanics for Full-Column Bolting

Objective: To develop fundamental knowledge and understanding of the behavior of full-column bolting in underground mines, especially using nonstandard grouts and bolts. This is a continuation of an ongoing project.

35. Destressing of Coal Mine Bounces, Coal Bursts, and Gas Outbursts in Deep Western Mines

Objective: To integrate field measurements and observations with numerical analysis and laboratory studies to gain a better fundamental understanding of why a bounce, burst, or outburst occurs and how to eliminate or reduce them in coal mine entries and longwall faces. This is a continuation of an ongoing project.

36. Theory and Mechanics of Roof Truss Behavior

Objective: To develop basic data on the support characteristics of roof trusses, and to evaluate concepts to provide faster and safer installation of trusses. This is a continuation of an ongoing project.

37. Effects of Bolt Installation Procedure on Mine Roof Stability

Objective: To determine bolting procedures that enhance or degrade roof stability. This is a continuation of an ongoing project.

38. Longwall Mining Investigations

Objective: To develop data on support loadings and strata activity associated with the development of longwall gateroad entries and subsequent mining of longwall panels; to evaluate materials for strata stabilization and void fillings. This is a continuation of an ongoing project.

39. Systems Interaction for Support Installation

Objective: To evaluate support installation concepts that remove the miner from immediate danger when placing bolts. This is a continuation of an ongoing project.

40. Retreat Mining Geomechanics

Objective: To determine the mechanisms of roof collapse during retreat mining and establish guidelines to improve the safety of retreat mining. This is a continuation of an ongoing effort.

41. Roof Bolt Torque and Load Research

Objective: To complete the development of a system of direct, in situ measurement of roof bolt tension. This is a continuation of an ongoing project.

Waste Stability

42. Generic Modeling of Waste Embankments and Backfilled Structures

Objective: To design and validate generic models via numerical model analysis and centrifuge testing for the evaluation of surface waste embankments and underground backfilled structures. This is a continuation of an ongoing project.

43. Surface Disposal of Mine Waste and Mill Tailings

Objective: To investigate methods of slurried waste deposition that will place higher strength materials close to

the embankment, and concepts for flocculation of fine coal waste that eliminate or reduce the need for slurry impoundments. This is a continuation of an ongoing project.

44. Stabilizing Oil Shale Waste

Objective: To determine the stability characteristics of oil shale retort wastes for surface and underground disposal. This is a new project.

45. Inundation Bulkhead Construction Using Sludge from Underground Acid Mine Drainage Treatment

Objective: To develop an effective and economical method to construct mine inundation bulkheads using dewatered limestone sludge from underground acid mine drainage treatment. This is a new project.

Industrial-Type Hazards

Program Objectives: To (1) determine how the quality of training can be increased to ensure miners can do their tasks safely and productively, (2) define the role of the human in all aspects of tasks required during the mining cycle, (3) determine how the human can be protected from the hazards of mining, (4) determine what information must be available to the miner and at what level to increase safety, and (5) determine what information must be available to reflect the human requirements in equipment designed for mining.

Electrical

1. Intrinsic Safety

Objective: To investigate problems related to the basic understanding of intrinsic safety, supply technical support to Bureau of Mines researchers, contractors, and MSHA, and participate in national and international committees to develop safety factors associated with using electrical equipment in potentially explosive atmospheres. This is a continuation of an ongoing project.

2. Permissible Equipment

Objective: To evaluate the use of stainless steel foams as a vent material on explosion-proof enclosures, and provide acceptance and test criteria for high-voltage permissible load centers. This is a continuation of an ongoing project.

3. Grounding and Ground Fault Protection

Objective: To improve existing sensitive ground fault interruptors or develop new units for use in U.S. underground mines, and to test those units for durability and shock prevention and establish applicable standards for future use. This is a continuation of an ongoing project.

4. Electrical Equipment, Devices and Systems

Objective: To investigate general power system problems that have the potential for causing mine fires, methane explosions, and exposure of mine personnel to electrical hazards, and to develop technology to improve the reliability and maintainability of mine power. This is a continuation of an ongoing project.

5. Inherently Safe Electrode Reactions for Use in Electrokinetic Dewatering

Objective: To complete the investigation on cathode reactions that will be inherently safe and can substitute for the hydrogen-generating reduction of water in the electrokinetic process of dewatering mine tailings. This is a continuation of an ongoing project.

Illumination

6. Investigation of Minimal Luminance Requirements for the Mining Industry

Objective: To collect and analyze data from surface and underground mines that can be used to evaluate and recommend minimal luminance levels for the industry. This is a continuation of an ongoing project.

7. Fundamental Research on Potential Use of Large Diameter Fiber Optics for Area Illumination

Objective: To evaluate the potential use of fiber optic illumination systems in underground mines with emphasis on glare reduction, safety, reliability, maintenance, and economics. This is a continuation of an ongoing project.

Mine Communications and Monitoring

8. Mine Telemetry and Environmental Surveillance Systems

Objective: To collect basic in-mine data on environmental mine monitoring systems. The data will be used for evaluation of system reliability, sensor and transducer performance, and data security. This is a continuation of an ongoing project.

9. Performance Standards and Systems Approach to Mine Monitoring

Objective: To develop and evaluate criteria for an intrinsically safe mine monitoring system. The research will concentrate on a systems approach, reliability, sensors, and data security. The system provides adequate safety protection that is cost effective. This is a continuation of an ongoing project.

10. Electromagnetic Signal Propagation in Underground Mines

Objective: To investigate techniques to permit whole-mine telemetry applicable to environmental monitoring, operational data transfer, and other communications. This is a continuation of an ongoing project.

Human Factors

11. The Investigation of Improved Management Practices for the Mining Industry

Objective: To ascertain the relationship of current management practices to miners' safety, productivity, and turnover rates; and on the basis of the findings from this work, recommend approaches

for the improved management of coal mines. This is a continuation of an ongoing project.

12. Human Factors of Manual Materials Handling in the Coal Mining Industry

Objective: To identify and define the hazards of manual materials handling in the coal mining industry, and to develop manual materials handling guidelines specific to the needs of the coal mining industry. This is a continuation of an ongoing project.

13. Computer Modeling of Mining Crew Stations

Objective: To determine the demands placed on mobile equipment operators while operating underground coal mining machinery and to incorporate the results into the ongoing work on developing a computer model of operator compartments. This is a continuation of an ongoing project.

14. Reduction of Human Error Accidents in Underground Mining

Objective: To reduce mining accidents and injuries associated with "human error," and to improve productivity related to human performance. This is a continuation of an ongoing project.

15. Research To Enhance the Conduct of New Hire, Refresher, and New Task Training

Objective: To enhance the efficiency and effectiveness of mine training through the systematic investigation, study, and development of performance criteria and competency-based training methods. This is a continuation of an ongoing project.

16. Field Evaluation of Prototype Training Equipment

Objective: To evaluate previously developed training equipment for continuous miners and underground and surface haulage vehicles. This is a continuation of an ongoing project.

17. Fundamental Factors of Operator Alertness To Enhance Surface Mining Safety

Objective: To determine human behavioral aspects of the man-machine-workplace interface that contribute to unsafe behavior in surface mining, develop practical techniques that can correct these problems, and test such techniques under controlled conditions that simulate the mining environment. This is a continuation of an ongoing project.

18. Blasters Training for Metal-Nonmetal Miners

Objective: To prepare recommendations for the development of materials that would be used for classroom and on-the-job training of blasters in metal and nonmetal mines. This is a continuation of an ongoing project.

Mine Equipment Safety

19. Application of Robotics to Underground Mining

Objective: To conduct an intensive, systematic study directed toward greater knowledge and understanding of robotics to determine the potential for the development of mining systems that will rely primarily on robotics technology to increase safety. This is a continuation of an ongoing project.

20. Equipment Technology for Reduced Accidents

Objective: To explore the application of innovative technology to improve health, safety, and productivity in mining. Areas addressed by the program are ground fall protection for operators of thin-seam face equipment, braking systems on mobile face equipment, and accidents analysis. This is a continuation of an ongoing effort.

21. The Fundamentals of Electromechanical Technology for Large Mobile Surface Mine Equipment Automation

Objective: To complete research on operator protection systems and collision avoidance systems for large surface mining equipment. Investigate the potential for using automation in surface mine safety. This is a continuation of an ongoing project.

Haulage and Materials Handling

22. Evaluation of Conveyor Belt Cleaners

Objective: To determine an optimum solution to the problem of carryback on conveyor belts, thus reducing worker exposure and potential danger from moving belts. This is a continuation of an ongoing project.

23. Hoisting Systems Research

Objective: To increase the safety and efficiency of hoisting operations by (1) quantifying the effects of degradation upon the structural integrity of hoist rope and (2) studying the relationship between material deformation and energy dissipation for utilization in hoist arrestments. This is a continuation of an ongoing project.

24. Haulage and Materials Handling Accident Reduction

Objective: To isolate the causes of powered haulage and materials handling accidents and to develop concepts and guidelines for equipment design that will reduce the injuries resulting from these operations in underground coal mines. This is a continuation of an ongoing project.

25. Wire Rope Inspection, Retirement, Selection, and Use

Objective: To investigate present methods and, where appropriate, derive better methods for inspection, use, and selection of underground mine hoist-rope and associated equipment, and to prepare new hoist-rope retirement (replacement) criteria. Existing inadequate retirement criteria will be replaced by improved criteria that will increase the reliability and safety of man and/or material hoisting operations. This is a continuation of an ongoing project.

26. Laboratory Analysis of Wire Rope

Objective: To define and control the microstructure of wrought, pearlitic steel, wire hoist ropes to extend fatigue life, and to perform metallurgical analyses such as chemical composition and microstructure determinations to support the needs of the entire Wire Rope Program at the Bureau of Mines Pittsburgh, Spokane, and Albany Research Centers. This is a continuation of an ongoing project.

Postdisaster

Program Objectives: To develop the technology that will enhance the chances of miners to escape, survive, and/or be rescued following a mine fire, explosion, or outburst of gas. This involves personal protection equipment for miners and rescue teams, preplanned rescue and survival systems, and devices to detect, locate, and communicate with trapped miners.

Survival

1. Life Support for Escape and Rescue

Objective: To conduct research to investigate the physiology of escape and rescue and the use of metabolic breathing simulators in testing and design of breathing apparatus, and to conduct long-term field evaluations of self-contained self-rescuers. This is a continuation of an ongoing project.

Communications

2. Systems and Strategies for Post-disaster Location and Rescue

Objective: To develop rescue strategies based upon in-mine medium frequency (MF) radio propagation. This is a continuation of an ongoing project.

Rescue and Mine Recovery

3. Gas Instrumentation for Rescue Teams

Objective: To quantify the effects of selected atmospheric and environmental parameters in commercially available methane detection instruments. This effort is in direct response to an MSHA request. This is a continuation of an ongoing project.

Explosives

Program Objectives: To maintain surveillance over permissible explosives and related items; determine hazard characteristics of explosive substances, devices, and systems not classified as permissible; and conduct research to support MSHA in establishing and enforcing meaningful standards and in investigating accidents related to explosives. To provide insight into physical and chemical aspects that cause explosives to malfunction. To improve blasting procedures that will reduce hazards associated with personnel control in blast-affected areas and flyrock. To provide information on stemming of large blastholes in gassy metal and nonmetal mines.

1. Development of Safer Blasting Procedures and Improved Explosive Hazard Techniques

Objective: To increase safety in blasting techniques and reduce explosive hazards in underground coal mines by (1) determining how blasting parameters affect the probability of ignition in multiple-delay blasting, (2) defining and evaluating new types of sheathed explosives for specific applications and then proposing scheduled tests for their

approval, and (3) providing hazard criteria and test procedures for new explosives, blasting agents, initiating systems, and related devices involved in accidents. This is a continuation of an ongoing project.

2. Effect of Explosive Properties and Blasting Procedures on Incendivity and Performance

Objective: To evaluate new candidate permissibles and ensure that certified permissibles are made to specifications. To study the deflagration and/or detonation of water-gel and emulsion permissibles. To improve blasting area security in gassy noncoal mines by selecting, modifying, and mine testing of intruder warning and detection systems. To determine minimum retention time of various stemming materials for blasting in oil shale and gassy underground mines. This is a continuation of an ongoing project.

3. Basic Understanding of Deflagration and Detonation Phenomena

Objective: To show the relationship between dynamic pressure densitization and delay time before detonation. To establish the relationship between deflagration tendency of mining explosives and the ignition condition utilized. This is a continuation of an ongoing project.

Systems Engineering

Program Objectives: To provide insight to the fundamental understanding of safety aspects concerned with automation/production in future mining systems, and to anticipate/delineate future mine safety problems so they can be treated rationally.

Systems Analysis

1. Effectiveness of Mine Systems

Objective: To provide a generic model with case examples to evaluate mine

safety technology for cost-effectiveness; and to perform mine hazard analyses of total mine operations and address interactions and address interactions among health and safety problems that occur. To update and expand data on mine equipment use for identifying potential hazards in coal mining operations; to study the demographics of the mining population in conjunction with Health and Safety Analysis Center accident injury data; and to adapt modern safety analysis methods to determine the severity of the more hazardous mining operations. This is a continuation of an ongoing project.

Test Facilities

2. Operation of the Lake Lynn Laboratory

Objective: To operate and maintain specialized full-scale underground and surface test facilities. Examples of research activities to be pursued include (1) reevaluation of passive barrier deployment guidelines, (2) test of triggered barrier systems mounted on a continuous miner, (3) validation of concepts on the ignition and propagation of coal dust explosions, (4) evaluation of large-scale burn tests involving explosives and blasting agents, and (5) acquisition of data for approval of sheathed explosive charges in novel applications. This is a continuation of an ongoing project.

3. Operation of the Safety Research Coal Mine and the Experimental Mine

Objective: To operate and maintain two specialized full-scale underground mine facilities at the Bureau's Pittsburgh Research Center, Bruceton, PA. Examples of research activities to be pursued include (1) identification of explosion hazards of float coal dust layers, (2) development of practical, economical, and reliable triggered and low-coal barriers,

(3) determination of the effects of large fires on mine ventilation systems, (4) evaluation of sealed mine fires and their extinguishment, and (5) evaluation of underground communication and monitoring systems. This is a continuation of an ongoing project.

4. Operation of the Twilight Mine Radiation Facility

Objective: To operate and maintain a specialized full-scale underground uranium mine for intercomparison tests to be conducted by the Bureau's Denver Research Center in conjunction with both international laboratories and instrument manufacturers. This is a continuation of an ongoing project.

Assistance With Program Management

5. Health and Safety Analysis Center (HSAC) Support

Objective: To provide the Bureau with easy access to statistical facts relating to employment and accident information collected and compiled by HSAC. This is a continuation of an ongoing project.

6. Information Retrieval Systems

Objective: To provide the Bureau with accident cost data for estimating tangible cost of occupational injuries, illnesses, and fatalities in the U.S. mining industry. This is a continuation of an ongoing project.

PART 2.--CONTRACT RESEARCH

HEALTH

Respirable Dust

Program Objectives: To investigate basic dust control technologies and concepts aimed at both preventing the formation of respirable dust and controlling the airborne dust generated during the mining cycle. To provide new and improved technology for measuring and controlling airborne respirable dust at levels that meet or are below standards set by Federal law for all mining and mineral processing operations.

1. Concepts for Reducing Silica Dust in Coal Mines

Objective: To identify concepts to reduce silica dust in underground coal mines. To reduce the concepts to practice through feasibility studies, proof-of-principle tests, and laboratory and

underground testing. Emphasis will be on concepts for drum-type continuous miners. This is a continuation of an ongoing project.

Noise Control

Program Objectives: To reduce mine worker overexposure to noise by conducting research in noise source identification, noise control technology, and hearing protector research.

1. Acoustic Modeling of Mining Environments

Objective: To develop an acoustic simulation of underground mines to evaluate noise control techniques and to assess worker overexposure to noise. Simulation is to provide for cost-benefit analysis of noise control measures. This is a new project.

Industrial Hygiene (Toxic Substances)

Program Objectives: To identify and control health hazards in surface and underground mines and mineral processing plants caused by toxic gases and fumes, and certain particulates produced by explosives, combustible materials, and diesel engines. To analyze alternative power sources that may have health advantages over existing mine diesels.

1. A Clean Internal Combustion Engine for Underground Mining Machinery

Objective: To determine the adequacy of the safety devices and systems of the prototype hydride-fueled mining vehicle currently being fabricated. This is a continuation of an ongoing project.

Ventilation

Program Objectives: To develop ventilation systems required to maintain a safe and healthful atmosphere conducive to efficient work output in noncoal mines.

1. Effective Face Ventilation Systems for Oil Shale Mines

Objective: To develop and evaluate conceptual designs for large-opening face ventilation systems and to in-mine-evaluate two of these designs. This is a continuation of an ongoing project.

SAFETY

Ground Control

Program Objectives: To develop technology that can be applied by the mining industry to reduce accidents due to the failure of underground mine roof, face, and ribs, and the collapse of surface mine and waste embankment slopes.

Mine Design and Development

1. Geological Conditions Affecting Coal Mine Roof Control in the Western United States

Objective: To conduct an overview of hazardous geologic conditions that affect underground coal mine roof stability in the Western United States. This is a continuation of an ongoing project.

Hazard Detection and Monitoring Systems

2. Coal Mine Bump Monitoring

Objective: To monitor a working section of a bump-prone underground coal mine in the Pocahontas coal basin, West Virginia, using Bureau-developed micro-seismic monitoring systems. This is a continuation of an ongoing project.

3. Focused Resistivity Method for Detecting Subsurface Coal Mine Workings

Objective: To improve the existing automated resistivity measurement system in order to extend the system's capability for detection of subsurface mine voids from the current limitation of 100 m to 200 to 300 m into coal-bearing strata. This is a continuation of an ongoing project.

Waste Stability

4. Additives for Strengthening Backfill Waste Materials in Steep Coal Seam Mining

Objective: To determine if cemented backfills can be formulated from coal washery wastes, pozzolanic materials, sand alluviums, and decomposed sandstone from a selected pitched seam coal mining region in Washington State. This is a continuation of an ongoing project.



UNITED STATES
DEPARTMENT OF THE INTERIOR

BUREAU OF MINES
4800 FORBES AVENUE
PITTSBURGH, PENNSYLVANIA 15213

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, \$300

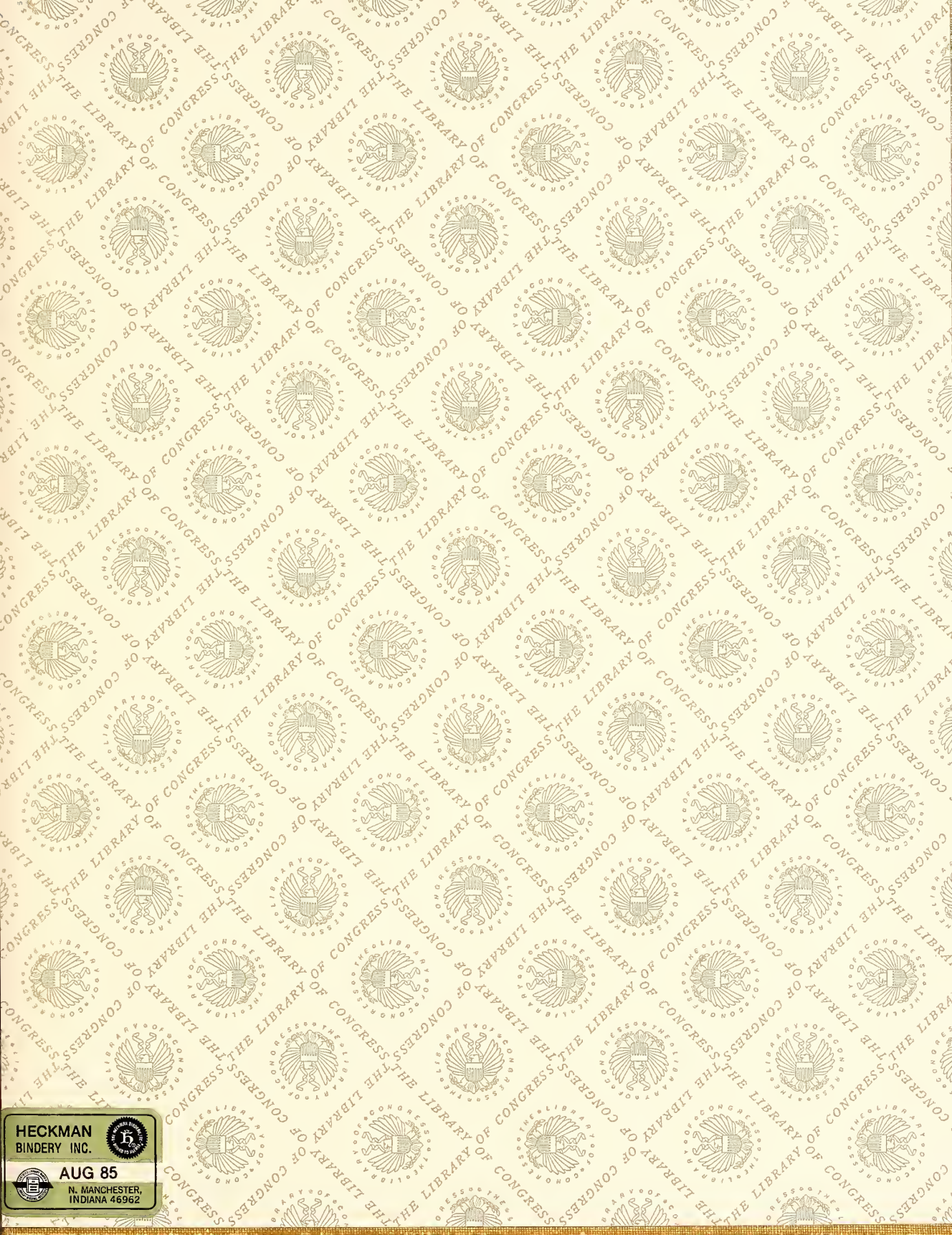
AN EQUAL OPPORTUNITY EMPLOYER

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF THE INTERIOR
INT-416

- ☐ Return to sender.
- ☐ Do not wish to receive this material, please remove from your mailing list.
- ☐ Address change. Please correct as indicated.

H 411 85 4





HECKMAN
BINDERY INC.



AUG 85

N. MANCHESTER,
INDIANA 46962

LIBRARY OF CONGRESS



0 002 955 866 8